Summary Report

A Carbon Tax Reform in China

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Section 1 Major Findings Environmental Related Taxes in China

1. China's Pollution Problem

In the wake of its economic miracle, China suffers from extensive environmental pollution. The severity of China's pollution problem can be seen from the following aspects:

1) Local Pollutants

Water Pollution: Water in China is seriously polluted and its industry is producing far more waste than previously realized. China's first census of pollution sources found that the nation's water is more heavily polluted than the official estimates originally reported. According to the census, the amount of pollution discharged into the water totaled 30.3 million metric tons in 2007—more than double the 13.8 million tons the government originally reported two years ago. In addition, based on the environmental statistical yearbook, the ratio of the occurrences of water pollution to overall environmental pollution increased from 52.4% in 1995 to 57.2% in 2006, implying the overwhelming evidence of worsened water pollution.

Solid Waste Pollution: China is producing much more industrial waste, including hazardous material in 2007 than ten years ago. Based on the statistical yearbook, the industrial solid waste totaled 1756.32 million tons in 2007 while the number is only 644.74 million tons in 1995.

Air Pollution: Air pollutants include sulfur dioxide, particulate matter, ozone, and nitrogen dioxide. During the period 1995-2007, industrial sulfur dioxide increased gradually. To be specific, the totality of sulfur dioxide emission increased from 14.05 million tons in 1995 to 21.39 million tons, with a growth rate of over 50%.

That environmental pollution is detrimental to human health is well recognized and documented (Pearce and Turner, 1991; Schwartz and Dockery, 1992; Wordly et al., 1997; Hansen and Selte, 2000; Jerrett et al., 2003; Neidell, 2004; Mead and Brajer, 2005; He, 2008). Air pollution can trigger or worsen a wide spectrum of respiratory and cardiovascular ailments. A World Health Organization (WHO) report estimates that diseases triggered by indoor and outdoor air pollution kill 656,000 Chinese citizens each year, and polluted drinking water kills another 95,600. China

accounts for roughly one-third of the global total for these pollutants, said Michal Krzyzanowski, an air quality adviser at the WHO Regional Office for Europe.

2) Global Pollutants

In addition to the local pollutants, China has also been harassed by rapid growth of global pollutants, mostly CO_2. CO_2 is the primary global warming gas and China has been contributing greatly to the world stock in recent years.

World Scenario: Global CO_2 emissions have three general characteristics:

i) *fast growth*: over centuries, the global CO_2 emissions increased from only 3 million tons in 1751 to 29.91 billion tons in 2008. The annual growth rate is 3% and only slightly below the world's real GDP growth rate of 3.78%;

ii) *concentrated emission*: geographically, 39.15% of CO_2 emissions are from continents Asia and Oceania. 23.57% are from the North-American countries and 15.68% are from European countries. Nationally, China and the United States contribute respectively 21% and 20.08% to global CO_2 emissions. The 10 countries with the largest proportions of CO_2 emissions are China, USA, Russia, India, Japan, Germany, Canada, UK, and Korea. They take up 65.59% of the global CO_2 emissions;

iii) *temporal-spatial shift*: geographically, the North-American and European countries contributed the most in CO_2 emissions in 1980. The ratios for these two continents are 29.68% and 24.51% respectively, while Asia and Oceania in total have only 19.51% of total world CO_2 emissions. Over a quarter of one century, the ratio is increased by 20% and these two continents became the most concentrated regions in CO_2 emissions. In addition, it appears that the concentration of CO_2 emissions moved from the developed countries to the developing countries.

China Scenario: CO_2 emissions in China have the following properties:

i) China's CO_2 emissions are in a fast-growing stage: Currently China has the most CO_2 emissions in the whole world which take up 21% of total world CO_2 emissions. According to our analysis, the density of CO_2 emissions, defined by the total CO_2 emissions divided by real GDP, has a tendency to decline with economic growth. In other words, without implementing any policy tools, economic growth will bring down CO_2 emission density. However we find the magnitude of CO_2 emission decline is rather small. We predicted that CO_2 density will only decrease by 9% of current level by 2020, implying the promise in Copenhagen cannot be fulfilled;

ii) China's CO_2 reduction costs are tremendous: first, we can look into China's energy structure. China uses mostly the coal as its energy source and the CO_2 emissions due to coal combustion take up 75.83% of all fuel usage. Compared to other countries, this number is big. Coal is abundant in China and has a fairly cheap price. If we switch the coal energy to oil or natural gas, then it means that we have to import mountainous energy resources other than coal, which will threaten the national energy security in China. Second, China still relies heavily on the development of heavy industries that use mostly coal in their production. The secondary sector in China contributes 49% to the national GDP, while the number for the United States is only 18%. To reduce coal usage

or to reduce CO_2 emissions from these industries will have a great impact on national economy;

iii) CO_2 emissions are concentrated in a few provinces: the top three provinces that emit the largest CO_2 have 33% of total national CO_2 emissions, and the first five provinces take up 50%. These provinces include developed provinces such as Shandong, Guangdong, Jiangsu, Zhejiang, and Shanghai etc, and also included are the energy-resourceful and energy-trade dependent provinces such as Xinjiang, Heilongjiang, and Gansu etc. CO_2 reduction will have devastating effect on the economy of these energy provinces.

iv) CO_2 emissions are concentrated in few industries: from the industrial sector perspective, the CO_2 emissions from the metal smelting industry occupy 30% of total amount from all industries, and the share is 12.4% from the chemical industry. Most importantly, these industries are fundamentally upstream industries and controlling CO_2 emissions of these industries can cause drastically adverse effects on the development of themselves and the downstream industries.

2. Policy Tools Available

In the international context, the Kyoto Protocol introduced several mechanisms that are designed for global emission reduction. These include the international emissions trading, joint implementation, clean development mechanism.

In the domestic context, theoretically cap-and-trade or energy tax can be used to realize effectively carbon emission control. While the former system can be used to reduce emissions compared to the environmental tax or energy tax, the cap-and-trade system is a relatively more complex system, which in general requires a nation to have a mature system of management and regulation, and to have an institution that is able to administer such a system in the process of pollution permits buying, selling, and arbitraging. For such reasons it is rather difficult, if not impossible, that the cap-and-trade system can be enforced in China at present.

On the other hand, carbon tax has several superiorities over the cap-and-trade policy instruments, especially for developing countries. These superiorities summarized by the Carbon Tax Center include:

i) Carbon taxes will lend predictability to energy prices;
ii) Carbon taxes will provide quicker results;
iii) Carbon taxes are transparent and are easier to understand than cap-and-trade;
iv) A carbon tax's simplicity inoculates it against the perverse incentives and potential for profiteering that will accompany cap-and-trade;
v) Carbon taxes address all sectors and activities producing carbon emissions;
vi) Carbon taxes can produce a far more equitable result than cap-and-trade.

3. Size and Composition of Environmental Related Taxes in China

According to the OECD, EED, and the COE, environmental tax is a kind of tax that is enforced by the government, free to levy, and has its base as a physical unit (or a proxy of it) that has a proven specific negative impact on the environment. The most common environmental taxes include energy taxes, transport taxes, pollution taxes and resources taxes. As a matter of fact, this

type of tax has been practiced in western countries since 1970s. The earliest pollution tax is the Pigovian tax. The carbon taxation was actually brought up in 1990s and Finland was the first country that put it into practice.

China hasn't implemented any alleged environmental taxes so far, but we do have taxes that play similar roles. The six categories of those taxes include transport fuel taxes, heating and processing fuel taxes, motor vehicle taxes, natural resources taxes, and waste and pollution emission taxes.

When take a further look at the details, we can see several interesting trends. In 2007, for example, China's environment related tax revenue to the share of the country's GDP is 2.41%, exceeding the average level of OECD countries. More specifically, within all those tax revenue, about 28% comes from motor vehicle taxes, 26% from electricity, 24% from heating and processing fuels, and another 10% from natural resources taxes.

4. The Overall Tax System is Regressive

A carbon tax is regressive by itself. However, the regressivity of a carbon tax can be minimized by keeping the tax revenue-neutral in a way that protects the less affluent.

5. The Potential for Renewable Energy Is Limited

Section 2 Design of Environmental Taxes

1. Current Situation in China

The current fiscal situation in China has already accompanied by heavy and fast-growing tax burden on individuals as well as industries. In addition, on the revenue side, the taxation is mainly composed of taxes on goods and services; on the expenditure side, the expenditure is mostly for the rich, not for the poor. Therefore the system is already regressive, and imposing a new, regressive carbon tax in China would deteriorate the current situation in China.

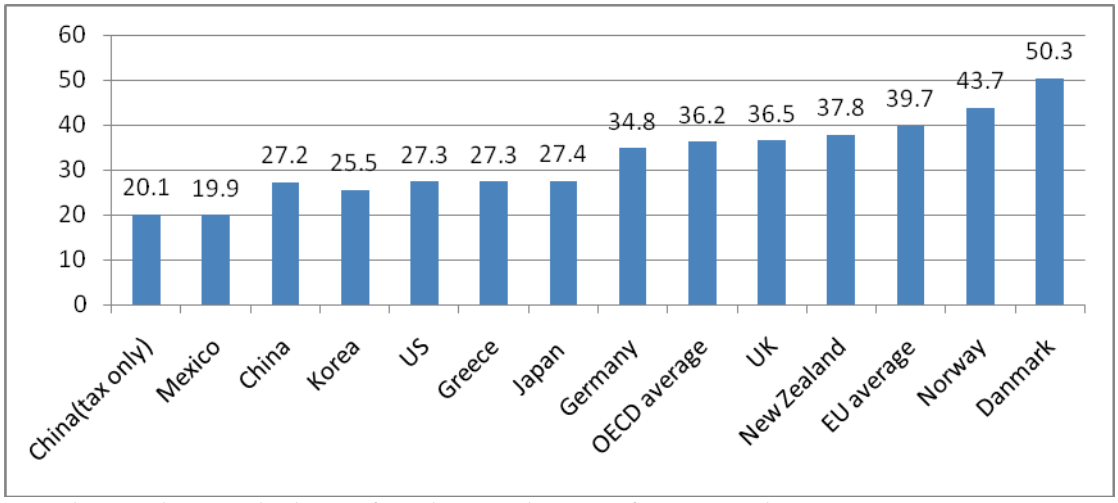
Tax Burden: The tax burden in China has increased very fast. Data shows that in the US, the tax burden increased from 25.6% in 1975 to 28.3% in 2007, which rises 2.7 percentage points in 32 years（http://www.oecd.org/dataoecd/48/27/41498733.pdf ）.While in China, it took only 13 years for the tax burden to increase from 15.9% in 1994 to 27.2% in 2007, with a increase of 11.3%. Such a high growth rate is abnormal in international experience. From the following table, we can see how tax burden has grown over years. The trend is very obvious no matter we use OECD definition or China definition.

Year	Tax Burden (OECD Definition)	Tax Burden (China definition)

1994	15.9%	10.5%
1995	15.4%	9.8%
1996	17.1%	9.9%
1997	15.8%	10.4%
1998	16.3%	10.8%
1999	17.7%	11.5%
2000	19.3%	12.8%
2001	20.6%	13.8%
2002	21.2%	14.1%
2003	22.0%	15.1%
2004	22.6%	16.1%
2005	23.6%	16.8%
2006	24.9%	17.8%
2007	27.2%	20.1%

Based on author's calculation.

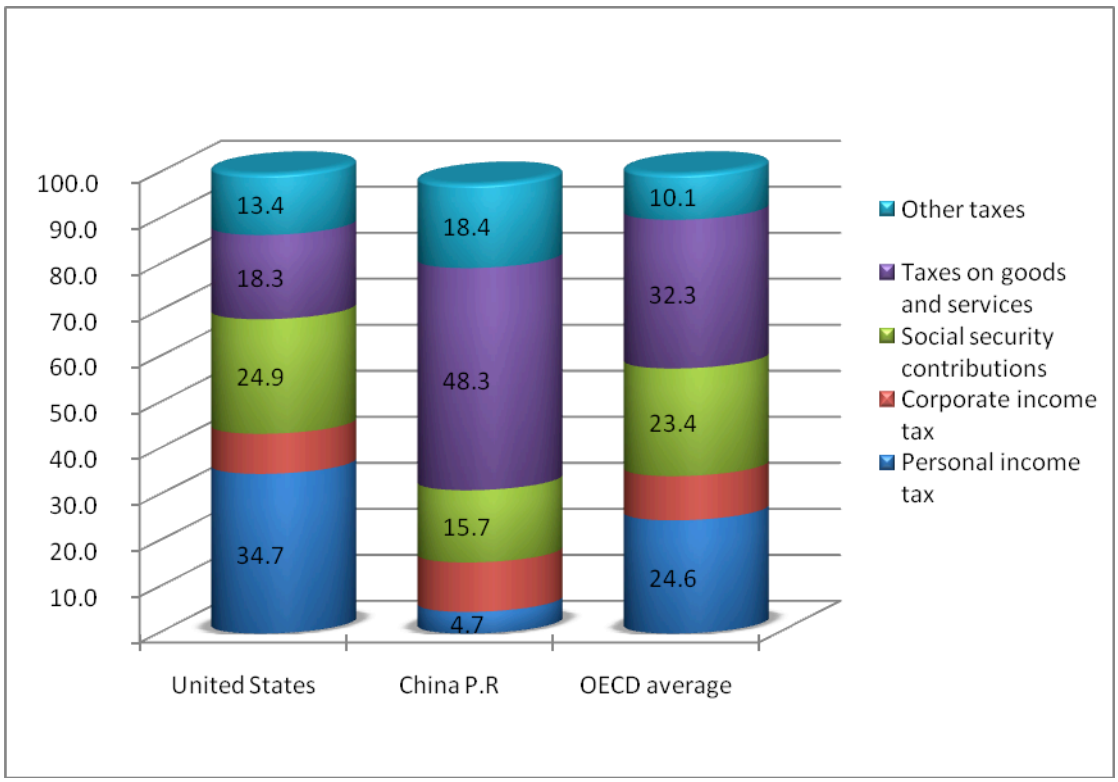
The following chart shows the comparison of tax burden across countries for 2007, based on OECD definition. The overall tax burden in China is comparable to the level of US and Greece.



Based on author's calculation for China and OECD for OECD data.

Therefore, impose a new tax would exert further burden on industries and not good for the competiveness of the industries in China.

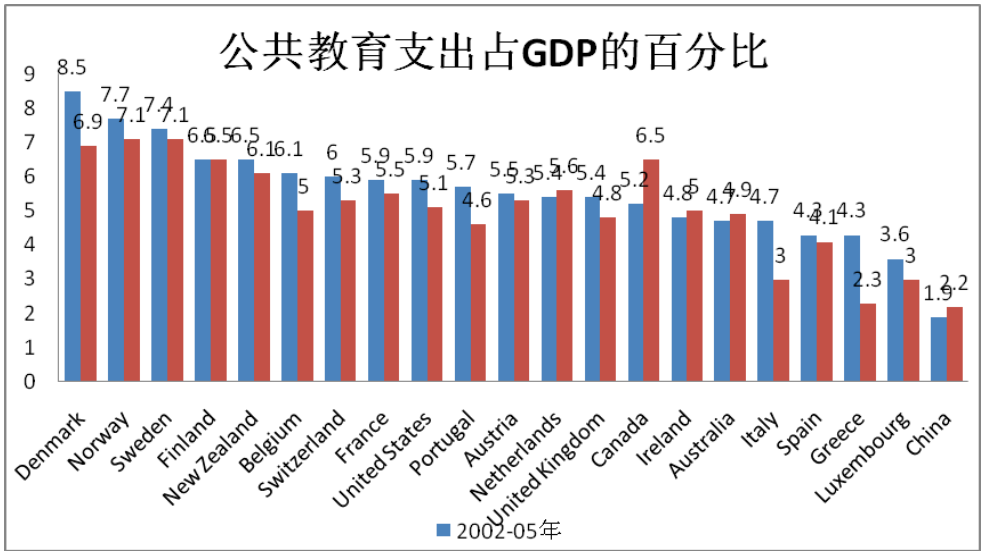
Progressivity of the System: this can be seen from both the expenditure side and the revenue side. On the revenue side, the indirect taxes provide major revenue sources for the Chinese government, for example, VAT and business taxes take up the share of 48.3% in total government revenue, far exceeding the share of 18.3% in the US and 32.3% in OECD countries. On the other hand, personal income tax that can play a major role in income redistribution and the main source of progressivity of the tax system, only takes the share of 4.7% in the total revenue, not only lower than the OECD average of 24.6%, but also lags far behind the US, which has a share of 34.7%. The following chart gives an intuitive comparison of the composition of tax revenue in China and the US, OECD averages.



Based on author's calculation for China and OECD for OECD data.

On the expenditure side, shares of expenditure on education, health and social assistance mainly for the low-income individuals are relatively low. Data shows that public expenditure on education only takes 2.2% of GDP; public expenditure on health only takes 2.3% of GDP, while expenditure for social assistance has a small share of 4.3%. The following tables and charts provide a comparison of China with other countries on these expenditure categories.

Percentage of public expenditure on education in GDP



	Percentage of public expenditure on education in GDP					Percentage of public expenditure on health in GDP				
	2000	**2002**	**2003**	**2004**	**2005**	**2000**	**2002**	**2003**	**2004**	**2005**
Australia	6.0	6.2	6.2	6.4	..	8.8	9.1	9.2	9.5	..
Austria	7.6	7.6	7.7	7.8	7.7	10.0	10.1	10.2	10.3	10.2
Belgium	6.6	6.7	7.2	7.5	7.4	8.6	9	10.1	10.2	10.3
Canada	6.2	6.7	6.8	6.8	6.9	8.8	9.6	9.8	9.8	9.8
Denmark	6.8	7.3	7.7	7.8	7.7	8.3	8.8	9.1	9.2	9.1
Finland	4.9	5.4	5.6	5.7	5.9	6.6	7	7.3	7.4	7.5
France	7.5	7.9	8.6	8.7	8.9	9.6	10	10.9	11.0	11.1
Germany	8.2	8.4	8.5	8.1	8.2	10.3	10.6	10.8	10.6	10.7
Greece	4.1	4.6	4.7	4.3	4.3	9.3	9.7	10.0	9.6	10.1
Hungary	4.9	5.3	5.9	5.7	..	6.9	7.6	8.3	8.1	..
Iceland	7.6	8.3	8.5	8.3	7.9	9.3	10	10.3	10.0	9.5
Ireland	4.6	5.4	5.6	5.8	5.8	6.3	7.2	7.3	7.5	7.5
Italy	5.8	6.2	6.2	6.6	6.8	8.1	8.3	8.3	8.7	8.9
Japan	6.2	6.5	6.6	6.6	..	7.7	8	8.1	8.0	..
Korea	2.2	2.7	2.8	2.9	3.2	4.8	5.3	5.4	5.5	6.0
Mexico	2.6	2.7	2.8	3.0	2.9	5.6	6.2	6.3	6.5	6.4
Netherlands	5.0	5.5	..	..	..	8.0	8.9	9.1	9.2	..
New Zealand	6.0	6.4	6.3	6.7	7.0	7.7	8.2	8.0	8.5	9.0
Norway	6.9	8.2	8.4	8.1	7.6	8.4	9.8	10.0	9.7	9.1
Portugal	6.4	6.5	7.1	7.2	7.4	8.8	9	9.7	10.0	10.2
Spain	5.2	5.2	5.5	5.7	5.9	7.2	7.3	7.8	8.1	8.3
Sweden	7.1	7.8	7.9	7.7	7.7	8.4	9.1	9.3	9.1	9.1
Switzerland	5.8	6.5	6.7	6.8	6.9	10.4	11.1	11.5	11.5	11.6
Turkey	4.2	5.2	5.4	5.6	5.4	6.6	7.4	7.6	7.7	7.6
United States	5.8	6.6	6.7	6.8	6.9	13.2	14.7	15.2	15.2	15.3
OECD Average	5.7	6.1	6.4	6.4	6.4	7.9	8.5	8.8	8.9	9.0
China	1.9	2.0	2.1	2.2	2.3	4.6	4.8	4.8	4.7	4.7

Comparison of China with OECD countries:
Percentage of public expenditure on social affairs in GDP, 2003

Country	**Percentage of public expenditure on social affairs in GDP**	**Country**	**Percentage of public expenditure on social affairs in government expenditure**
Sweden	31.3	**Germany**	58.30%
France	28.7	**Switzerland**	57.70%
Denmark	27.6	**Sweden**	54.60%

Germany	27.3	**Norway**	54.10%
Belgium	26.5	**Belgium**	53.80%
Austria	26.1	**France**	53.70%
Norway	25.1	**Spain**	52.60%
Italy	24.2	**Austria**	51.60%
EU15 average	23.9	**Poland**	50.90%
Portugal	23.5	**Italy**	49.90%
Poland	22.9	**Australia**	49.40%
Hungary	22.7	**Denmark**	49.00%
Finland	22.5	**New Zealand**	48.60%
Luxembourg	22.2	**Portugal**	48.60%
Greece	21.3	**Luxembourg**	48.40%
Netherlands	20.7	**United Kingdom**	46.90%
OECD average	20.7	**Ireland**	46.50%
United Kingdom	20.6	**Hungary**	46.40%
Switzerland	20.5	**Japan**	46.30%
Spain	20.3	**United States**	44.40%
New Zealand	18	**Finland**	44.40%
Australia	17.9	**Netherlands**	42.60%
Japan	17.7	**Canada**	42.10%
Canada	17.3	**Greece**	41.00%
United States	16.2	**Iceland**	39.30%
Mexico	6.8	**Slovak Republic**	35.30%
Korea	5.7	**Korea**	18.40%
China	**4.3**	**China**	**17.80%**

Therefore, the system is regressive. Imposing a regressive carbon tax will make the situation worse-off. That's why we need the CO_2 taxes to adhere to the following principles.

2. **The Three Principles of CO2 Taxes**

1) Revenue Neutrality: A carbon tax should be revenue-neutral. Revenue-neutral means that any of the tax revenues raised by taxing carbon emissions should be returned to the public. When a new carbon tax or energy tax is introduced, the government should lower other taxes to keep total tax revenue constant, or subsidize to particular sectors that suffer most.

2) Competitiveness Neutrality: A right carbon tax should preserve the competitiveness of an enterprise. Adding this new tax to the cost of doing business may undermine existing enterprises and discourage investment in new ones. A carbon tax affects a firm's competitiveness by changing its relative production costs. For example, if a firm makes intensive use of energy, ceteris paribus, then imposing a carbon/energy tax will increase its production cost relative to those less energy-intensive firms in the short term. Thus, it would experience a decline in competitiveness, whereas less energy-intensive firms would obtain a relative cost advantage in

the short term. The potentially high-energy carbon taxes underline the importance to mitigate their competitiveness effects in designing the taxes. One commonly used way is to grant energy-intensive industries a lower tax rate than, e.g. households, or even to exempt these industries from coverage of the taxes.

3) Distribution Neutrality: the policy makers should be careful about the impact of carbon tax on the distribution of income. Since lower income households spend a larger proportion of their income on energy than higher income households do, a carbon tax is expected to have a regressive impact on the distribution of income. In calculating the distributional effects on different income groups of a mixed carbon and energy tax, Smith (1992) finds that the relative burden of the additional tax would be heavier for the poorest decile and lower for the richest, which is supported by Poterba (1991)'s finding that when the US imposed a tax of $100 per ton of carbon, the tax burden would amount to 10% of income for the lowest income group, whereas the corresponding figure would amount only to 1.5% for the highest income group.

One way to mitigate the regressive distributional impacts is to set a tax-free allowance for essential use of energy. For instance, energy could be taxed only above a certain floor, so that each household has a tax free energy allowance. The idea is that some amount of energy is necessary to satisfy basic needs. Above that floor, energy would be progressively taxed to provide the incentive for reducing energy consumption.

Before starting this carbon tax reform, we should also take a look at other countries' examples. In fact, the western countries have been practicing the ecological tax reform (ETR) since the end of the last century. They employed different ways in the process but all share one common goal: to promote environmental protection while also enhance economic growth. Most countries introduced tax cuts and subsidies to particular groups, and invented new taxes or changed the rates of some non-environmental taxes to offset their carbon tax revenue lost. From their experiences, we can see that carbon tax is just one item of the whole carbon reduction package and is a part of the fiscal policy. The government should introduce it via a 'phased-in' method that takes inflation into consideration. Moreover, we should provide tax cuts or exemptions to energy-intense industries as well as internationally competitive industries.

3. Restructuring of current VAT Tax System

4. Tax Bases and Tax Rates

At present, six major carbon taxes are being used in China: transport fuel tax, coal tax, natural gas added-value tax, natural resource tax, LPG tax, as well as other indirect carbon taxes. We do see a need to reform those taxes and introduce new ones. And to assure the effectiveness of all such carbon taxes, we should carefully draft their tax rates, include suite tax bases, and take consideration of outside factors such as the international oil prices.

5. The Use of CO2 Taxes

Carbon tax helps to reduce greenhouse gas emissions in four major aspects: First, Carbon taxes reduce CO_2 emissions through both their price mechanism effects on energy consumption and

fuel choice. Second, it can possibly raise the capital for the investment of clean energy. Third, it would intrigue the formation of a more efficient market. Fourth, it would boost the adoption of clean energy and carbon reduction technologies.